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A Integrated Technique of SIDO PFC Fly back Converter in power system

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ABSTRACT

Energy saving is the major international efforts to control down the global warming .Power electronics based devices has being improving day by day for saving the electrical energy in the power grids. The govt. of India is also contributing several projects based on energy conservation. The Designing of a single-inductor dual output (SIDO) fly-back power factor correction (PFC) converter is proposed, in which the PFC and power conversion are done at the same time, multiplexing of a single-inductor is implemented through which each output can be regulated independently. The converter will be operating under in critical conduction mode (CRM).

A SIDO PFC converter is a system of dual efficient DC output obtained from the AC source, it can also be replaced by solar panel and our system is capable of running a dc motor also, fly back converter can be used in both ac-dc and dc-dc conversion process. The efficiency along with power factor, total harmonic distortion (THD), settling time and output accuracy of this converter will be improved by implementing the neural network as controllers in the system

KEYWORDS: *KeCritical Conduction Mode (CRM), Power Factor Correction (PFC), Single Stage Single Inductor Dual output (SIDO), Time Multiplexing*

I. Introduction

Power electronics is a field in electrical engineering that deals with converting an available form of energy from a power source to the form required by a load. A power converter uses semiconductor devices such as diodes, MOSFETs and IGBTs to achieve this power conversion. Diodes are uncontrolled switches that turn on and conduct current when they are forward-biased and turn off when they are reverse-biased; MOSFETs and IGBTs are controlled switches that can be turned on or off by a switching signal at their gate (i.e. a high gating pulse is the turn-on command and a low or zero gating pulse is the turn-off command). A power converter can be an AC/DC converter, DC/DC converter, DC/AC inverter or AC/AC converter depending on the application. Many types of power sources can be used for these converters, such as AC single-phase, AC three-phase, DC source, battery, solar panel, or an electric generator. Electricity has majorly three systems i.e. generation, transmission, and distribution systems. in all the three systems the transmission plays a major role while transferring the energy. The complete transmission is designed to achieve high output power that is being provided to the distribution system. Therefore the main issue is to reduce the difference between the input and output power of the transmission. So as to achieve high power factor (PF) and to accurately regulate output voltages or currents of multiple output ac/dc converter, conventional multiple output ac/dc power device consisting of two-stage power conversion is employed, as shown in Fig 1, wherever PFC pre-regulator provides dc bus voltage Vbus, and parallel connected dc-to-dc regulators are used to regulate output voltage or output current from Vbus. The circuit configuration of multiple output ac/dc device shown in Fig.1 is complicated and suffers from high cost, with multiple inductors and controllers are needed .Moreover, the two-stage power

conversion with PFC pre-regulator and dc-to-dc converters suffer from lower efficiency and higher volume and cost. However, single-stage PFC device can achieve high PF and output current or voltage regulation at an equivalent time. Hence, it's drawn more and more attention in recent years Fly back PFC device with multiple secondary windings is a typical single-stage multiple outputs device.

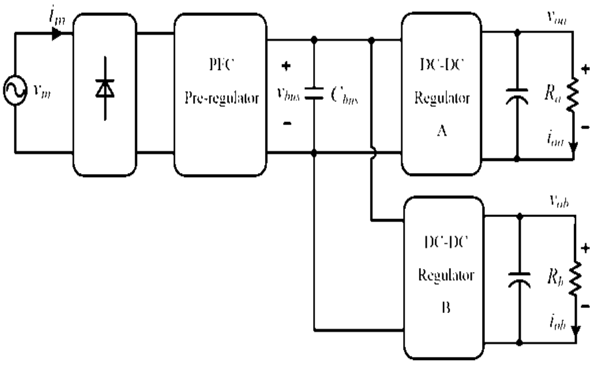


Fig 1 - **Block diagram of a conventional multiple output ac/dc power device with high power factor**

Single-inductor multiple-output (SIMO) device with only one inductor edges from vital overall cost saving, small size and light weight, that make it as one of the foremost suitable and cost-efficient solutions for multiple output power provides. Single-stage fly back PFC device has the advantage of low value and high power factor that build it wide applied in single-output non-isolated general lighting application. During this paper, one electrical device dual-output (SIDO) fly back PFC device in operation in important physical phenomenon mode (CRM) is projected. Its management strategy and corresponding characteristics area unit analyzed. Independent regulation of every output is achieved during this device by multiplexing one electrical device. Compared with standard two-stage multiple output device, the projected device edges with vital overall value saving, small size, light weight and high power conversion efficiency due to single stage power conversion. The projected device also can be extended by a solar array as input supply with multi output capable of running a dc motor .In this paper, fly back device is employed to enhance the power factor of the system.

II. Proposed System

A. Structure and Principle

The structure of the fly back converter and the operating principle can be explained as under:

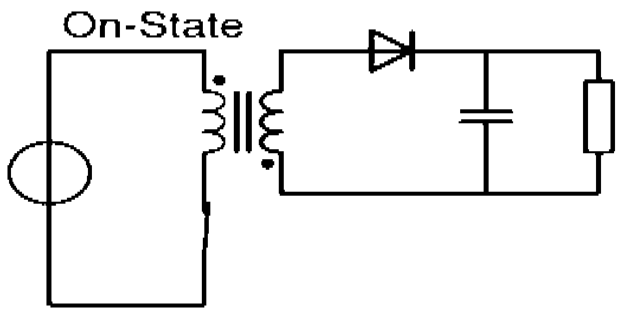


Fig 4 The configurations of a fly back converter in operation: In the on-state, the energy is transferred from the input voltage source to the transformer (the output capacitor supplies energy to the output load).

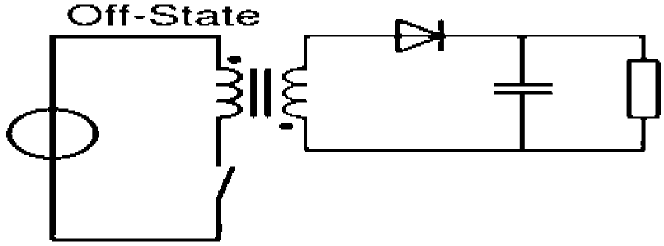


Fig 5 In the off-state, the energy is transferred from the transformer to the output load (and the output capacitor).

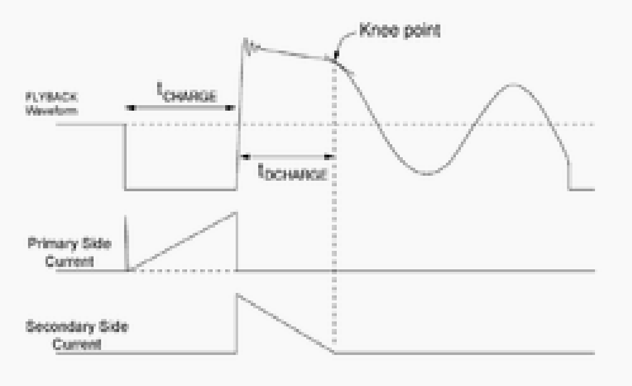


Fig.6 Waveform - using primary side sensing techniques - showing the 'knee point'.

The schematic of a fly back converter can be seen in Fig. It is equivalent to that of a buck-boost converter with the inductor split to form a transformer. Therefore the operating principle of both converters is very close, when the switch is closed the primary of the transformer is directly connected to the input voltage source. The primary current and magnetic flux in the transformer increases, storing energy in the transformer. The voltage induced in the secondary winding is negative, so the diode is reverse-biased (i.e., blocked). The output capacitor supplies energy to the output load.

When the switch is opened, the primary current and magnetic flux drops. The secondary voltage is positive, forward-biasing the diode, allowing current to flow from the transformer. The energy from the transformer core recharges the capacitor and supplies the load. The operation of storing

energy in the transformer before transferring to the output of the converter allows the topology to easily generate multiple outputs with little additional circuitry, although the output voltages have to be able to match each other through the turns ratio. Also there is a need for a controlling rail which has to be loaded before load is applied to the uncontrolled rails, this is to allow the PWM to open up and supply enough energy to the transformer.

III. Operations

The fly back converter is an isolated power converter. The two prevailing control schemes are voltage mode control and current mode control (in the majority of cases current mode control needs to be dominant for stability during operation). Both require a signal related to the output voltage. There are three common ways to generate this voltage. The first is to use an optocoupler on the secondary circuitry to send a signal to the controller. The second is to wind a separate winding on the coil and rely on the cross regulation of the design. The third consists on sampling the voltage amplitude on the primary side, during the discharge, referenced to the standing primary DC voltage.

The first technique involving an opto coupler has been used to obtain tight voltage and current regulation; whereas the second approach has been developed for cost-sensitive applications where the output does not need to be as tightly controlled, but up to 11 components including the opto coupler could be eliminated from the overall design. Also, in applications where reliability is critical, optocouplers can be detrimental to the MTBF (Mean Time Between Failure) calculations. The third technique, primary-side sensing, can be as accurate as the first and more economical than the second, yet requires a minimum load so that the discharge-event keeps occurring, providing the opportunities to sample the 1:N secondary voltage at the primary winding.

A variation in primary-side sensing technology is where the output voltage and current are regulated by monitoring the waveforms in the auxiliary winding used to power the control IC itself, which have improved the accuracy of both voltage and current regulation. The auxiliary primary winding is used in the same discharge phase as the remaining secondary's, but it builds a rectified voltage referenced commonly with the primary DC, hence considered on the primary side.

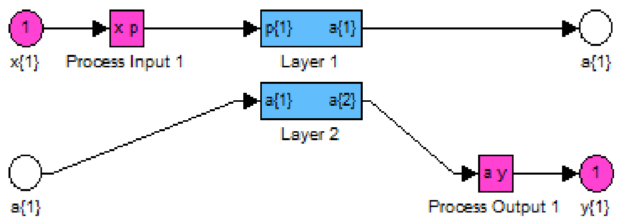
Previously, a measurement was taken across the whole of the fly back waveform which led to error, but it was realized that measurements at the so-called *knee point*, allow for a much more accurate measurement of what is happening on the secondary side. This topology is now replacing ringing choke converters (RCCs) in applications such as mobile phone chargers

A. Artificial Neutral Networks (ANN)

In the existing method voltage sag and swell are detected by the ANN (Artificial Neural Network).We need for this system design of neural network. This system is also use Digital Signal Processing. The ANN includes a large number of strongly connected elements. Then the neurons are interconnecting creating different layer. In this work, a Feed forward ANN has been designed for transient disturbance measurements.

Artificial Neural Networks, which are simplified models of the biological neuron system, is a massively parallel distributed processing system made up of highly interconnected neural computing elements that have the ability to learn & thereby acquire knowledge & make it available for use.

ANNs are simplified imitations of the central nervous system, and obviously therefore, have been motivated by the kind of computing performed by the human brain. Hence the technology, which has been built on a simplified imitation of computing by neurons of a brain, has been termed Artificial Neural System (ANS) technology or Artificial Neural Network (ANN) or simply Neural Networks.



➢ ***Architecture of Neural Network***

The architecture of ANN is classified into three layers: These layers are given below.

- Input Layer: There are some different nodes are present in input layer which is distributing the data and information to other layer but not process for this.
- Hidden Layers: This is the mid layer of this network. The hidden layer was provided the network the ability to map or classify the non-linear problem. This layer is not visible directly.

- Output Layer: A node present in output layer which is use for encode possible value.

In existing project they are use a back propagation network. Back propagation is type of neurons. Back propagation is stands for backward propagation of error. This is the common method of training Artificial Neural Network.

IV. Simulation Design of the System

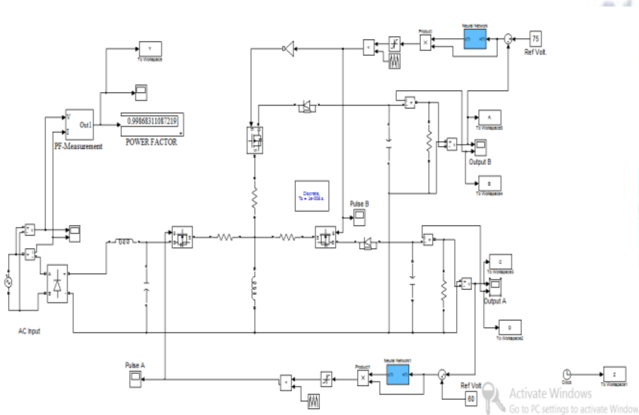


Fig 6 Model design of the system

The designs of the single inductor dual output fly back power factor correction converter have the following circuit parameter which is as follows:-

S.NO	VARIABLE	DEFINITION	VALUE
01	V_{in}	Input voltage	100-240 v ac
02	R_a	Rated load resistor of output A	300 ohms
03	I_{oa}	Current of output A	o.2 A
04	R_b	Rated load resistor of output B	300 ohms
05	I_{ob}	Current of output B	0.25 A
06	L	Inductor	180 uH
07	L_f	Input filter inductor	1mH
08	C_f	Input filter capacitor	220 nF
09	C_1 ,C_2	Output filter capacitor	950 uF

A. Working

In this section, the SIDO fly back PFC converter operating CRM is analyzed under the following assumptions.

1) All the components are ideal.

2) The switching frequency fsw is much higher than the line frequency 2fL, i.e. fsw>>2fL, input voltage can thus be considered as constant in a switching cycle.

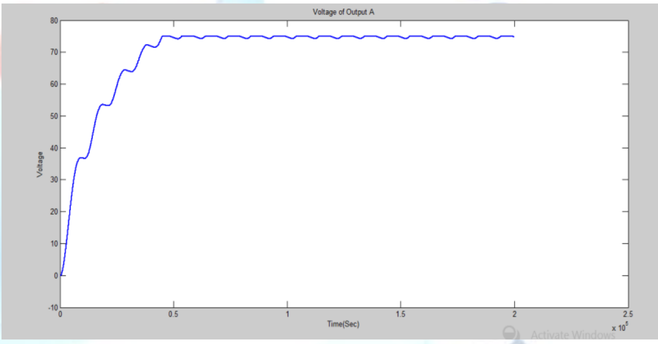
3) The input voltage is a full-wave rectified sine wave, i.e., Vin, rec (t) = |vin (t)|=Vp|sin (ωLt)|, where Vp is the amplitude and ωL = 2πfL is the angular frequency of AC input voltage.

4) The output voltage Voa and Vob are constant, i.e. they have a negligible ac ripple in Steady state.

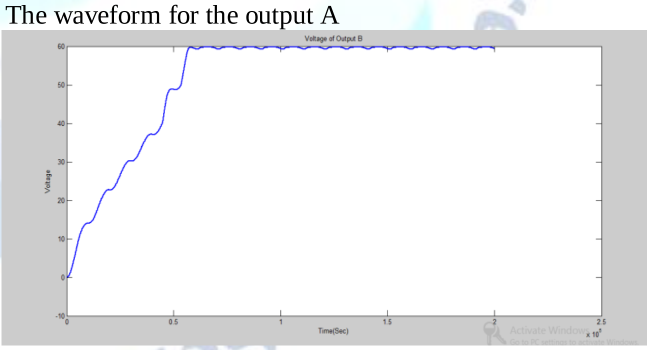
5) As the bandwidth of the control loop of PFC Converter is usually much lower than the rectified line frequency (2fL), the error voltage of each output Ve[i] (i=1, 2) are constant within each half of a line cycle, i.e., constant on time control can be achieved by controller.

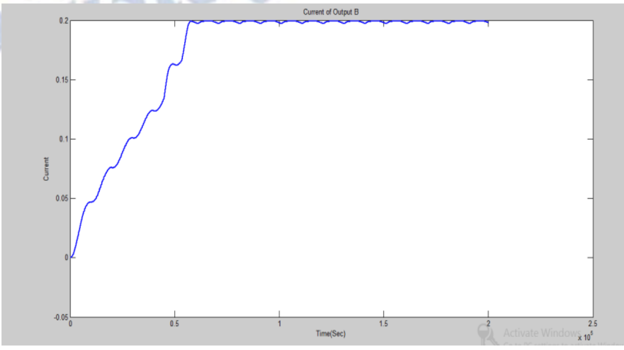
The working of a single-inductor dual output fly-back power factor correction converter can be explained, in which the multiplexing of a single-inductor is implemented through which each of two output can be regulated independently. The fly back converter will be operating under in critical conduction mode.

B. Simulation System's output Result

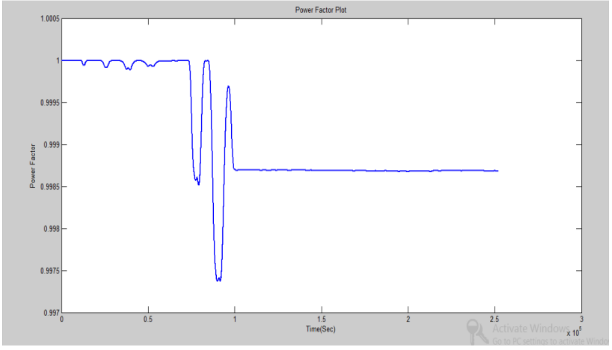


The waveform for the output A

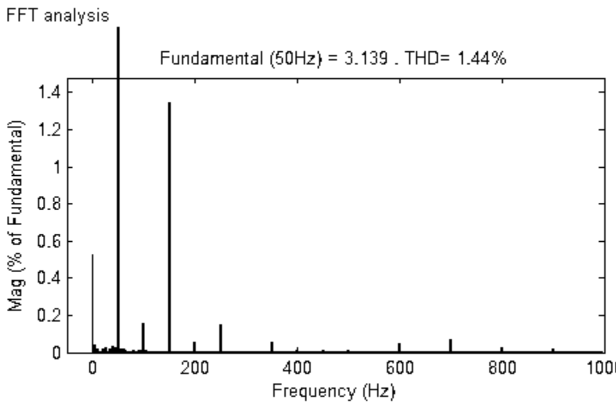




The waveform for the output B



The power factor waveform the system.



The THD of the system

V. Conclusion

A single-inductor dual-output fly back PFC converter operating CRM is proposed in this paper. Each output can be regulated independently in this converter by multiplexing a single inductor and by implementing the neural network technique to increase the power factor of the system .Compared with conventional two-stage multiple output ac/dc converters, the proposed single-stage multiple output ac/dc converter benefits from significant overall cost saving, small size and light weight of device. Although only dual-output converter is discussed in detailed in this paper, the proposed converter can be easily extended to realize SIMO PFC converters and solar panel can be used as dc input source in the system. By the experimental verification the system efficiency is 98.56 % and the power factor is 0.998 with THD only 1.44 %.

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

Appendix

Appendixes, if needed, appear before the acknowledgment.

Acknowledgment

The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank ... .” Instead, write “F. A. Author thanks ... .” **Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page**.

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